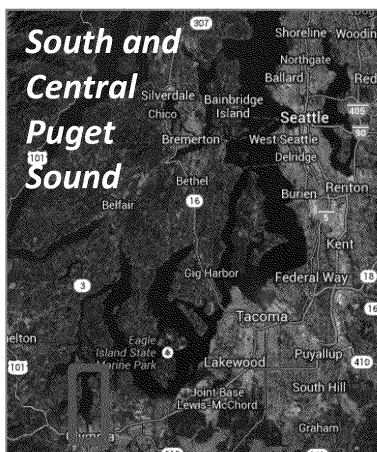
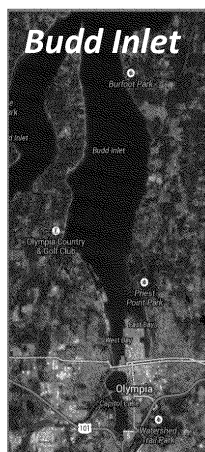


Dissolved oxygen impacts in Budd Inlet, South Puget Sound, and the Salish Sea

Briefing for EPA – 9/26/13



Mindy Roberts, Anise Ahmed, and Greg Pelletier
(Department of Ecology, Environmental Assessment Program)

Salish Sea includes Puget Sound, Strait of Juan de Fuca, and the Georgia Strait, including Canada

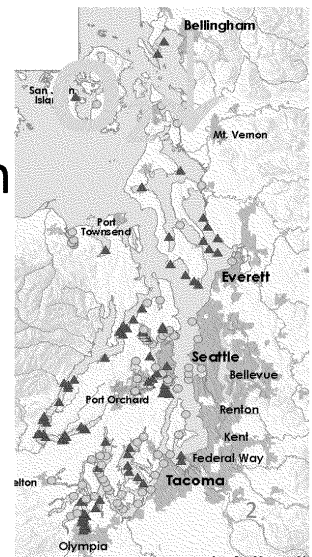
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How are oxygen and nitrogen related?

- Human activities add nitrogen through wastewater, manure, fertilizer, etc.
- Nitrogen fuels algae blooms in Puget Sound
- As algae decomposes, it draws down oxygen
- Fish, and other aquatic life, need oxygen to breathe
- Same questions as in Chesapeake Bay, Long Island Sound, Gulf of Mexico

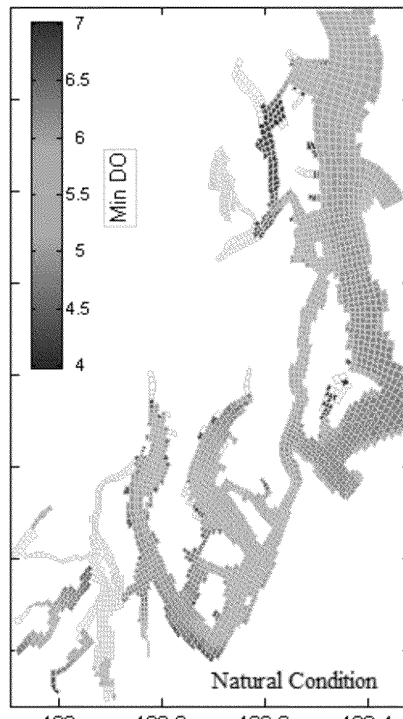
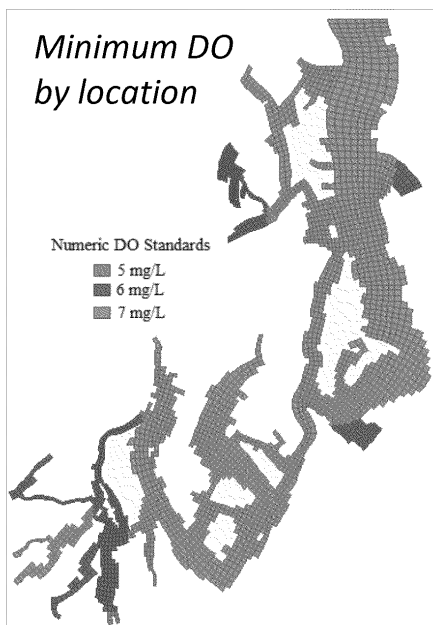
+N

→algae



How do the Water Quality Standards for oxygen (DO) work in Puget Sound?

- Oxygen > 7 mg/L (varies by location)

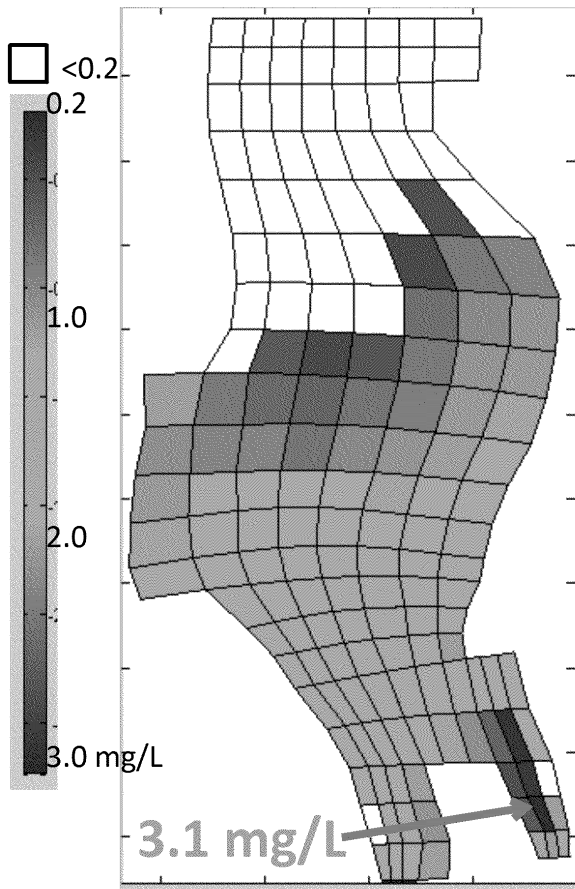


- If naturally < 7 mg/L, total human impact cannot cause oxygen to decline more than 0.2 mg/L

What are the key questions for Ecology?

- How much is natural and how much is human?
 - *Need sophisticated computer models to distinguish*
- How much reduction is needed to meet water quality standards?
- Are permit changes needed to meet water-quality based effluent limits?

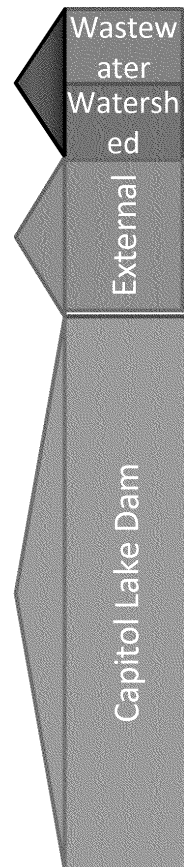
Budd Inlet findings: Human activities cause dissolved oxygen to decline as much as 3 mg/L below natural



Local sources
need reductions

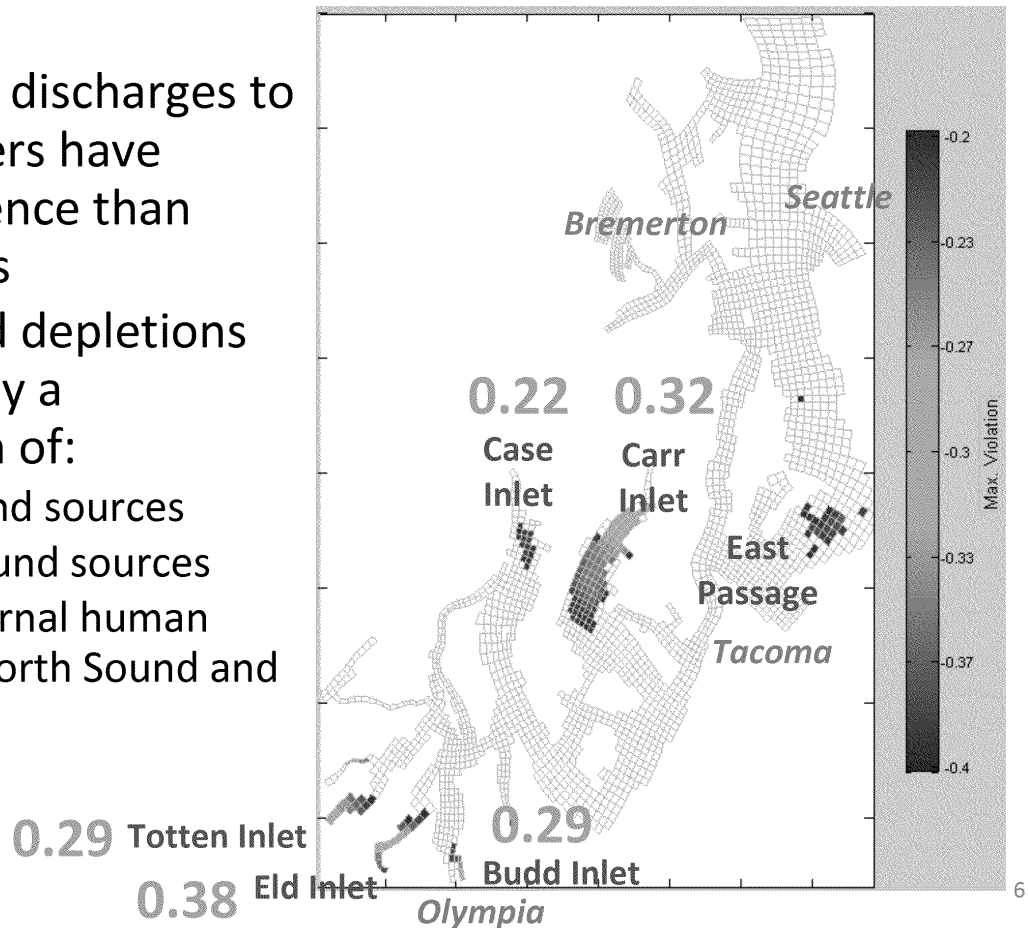
External sources
need reductions

Capitol Lake dam
has the largest
impact on Budd
Inlet oxygen and
needs reduction



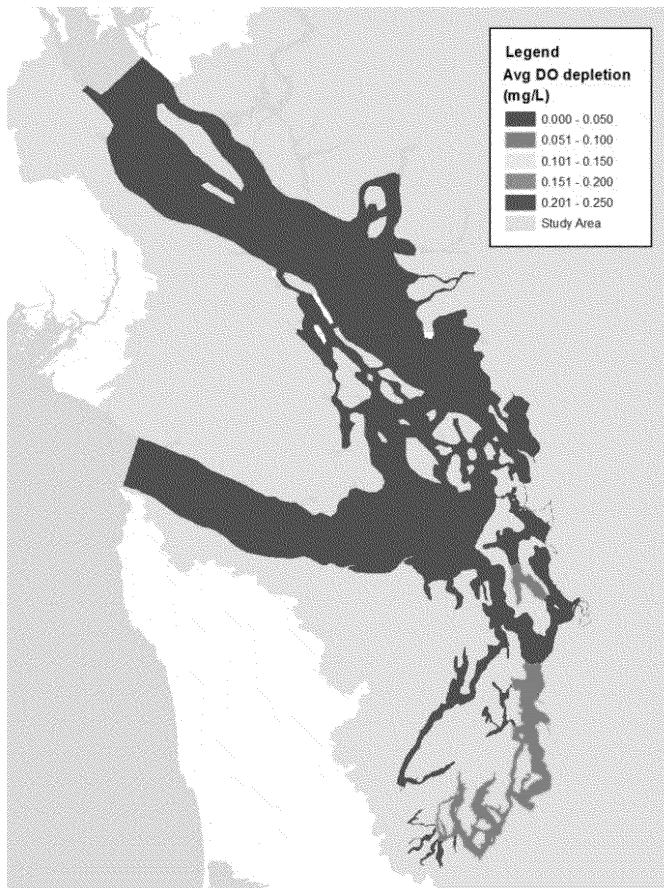
South (and Central) Puget Sound findings: Current human sources cause oxygen to decline as much as 0.4 mg/L

- Wastewater discharges to marine waters have bigger influence than river sources
- South Sound depletions influenced by a combination of:
 - South Sound sources
 - Central Sound sources
 - Other external human sources (North Sound and beyond?)



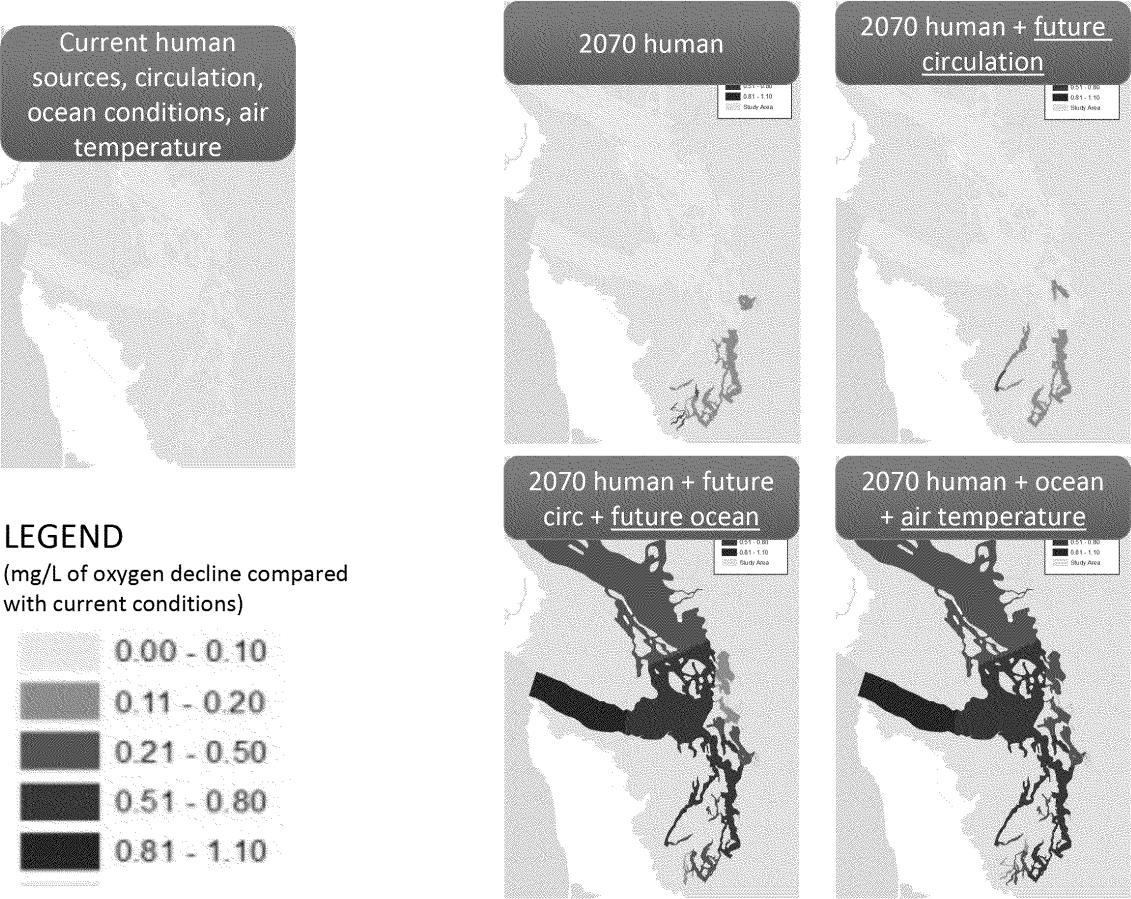
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Salish Sea findings: Current human sources cause oxygen to decline as much as 0.1 mg/L



- Wastewater discharges to marine waters have bigger influence than river sources
- South and Central Puget Sound reflect greatest impact from human sources

Salish Sea findings: Future population growth will increase oxygen impacts; ocean makes it even worse

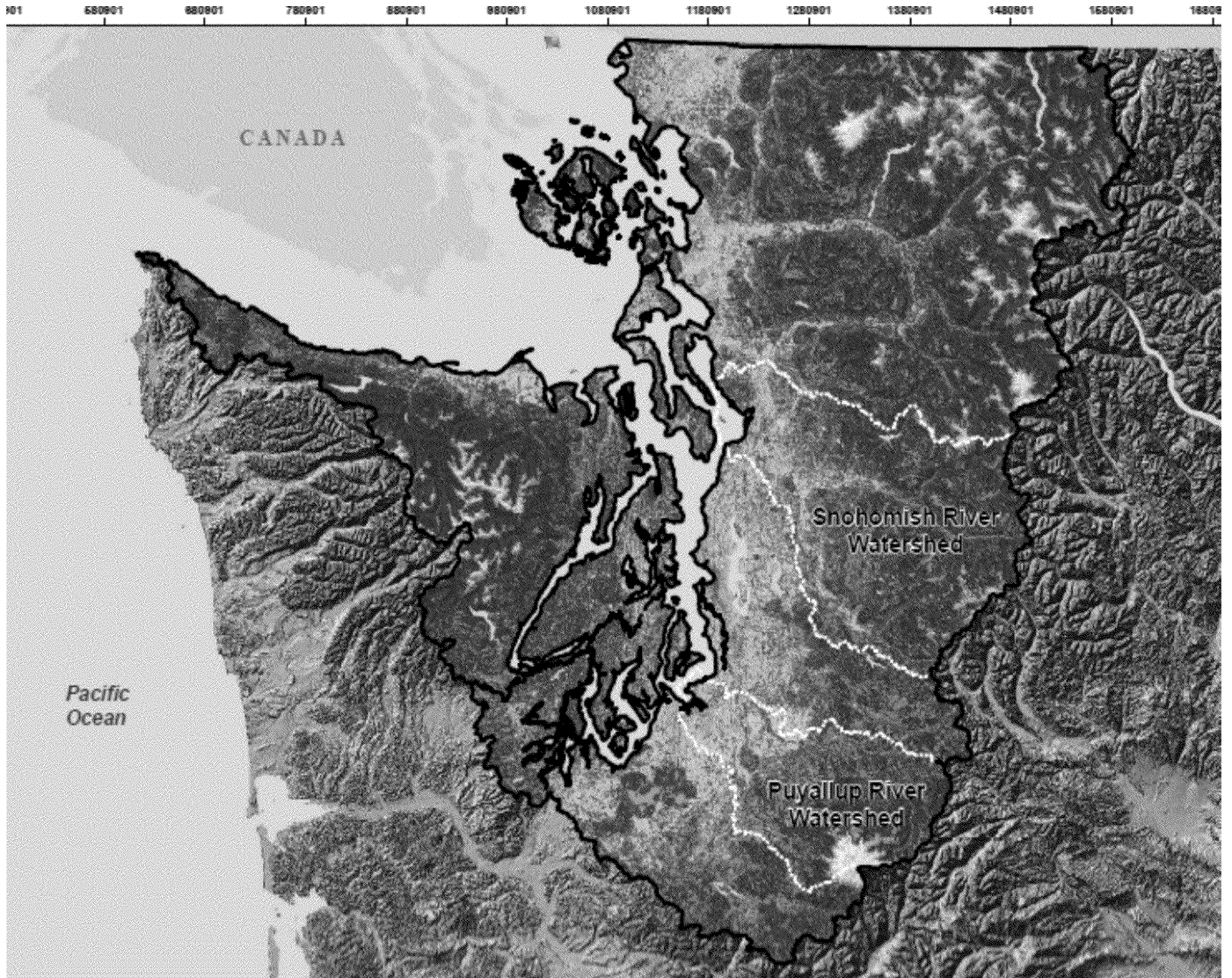


Uncertainties

- Inherent model error
 - Similar to other models used to regulate sources
 - Unknowns including climate change and ocean boundary changes
- Future sediment enrichment
 - Model currently has no sediment “model”
 - DO is sensitive to sediment assumptions
 - Our current assumptions are conservative
 - Next phase is to improve enrichment prediction

Key findings

- Ocean conditions are dominant
- Human impacts are achieving water quality standards in many areas today
- Portions of South and Central Puget Sound are just over the standards today
 - Model uncertainty
 - Standards could face scrutiny
- Budd Inlet impacts must be reduced to meet standards



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Key messages

- Actions are needed to help Budd Inlet meet standards
- Wastewater discharges are at or approaching levels of regulatory concern in South and Central Puget Sound now and will increase with population
- We do not have enough scientific certainty for immediate regulatory action
- We recommend additional analyses of both models
- When impacts are close to 0.2 mg/L, standards could face scrutiny

Project next steps

- *We invite interested parties to work with us to improve the models*
- Budd Inlet:
 - WQP continuing with Deschutes River TMDL
 - Unclear path for Capitol Lake and Budd Inlet TMDL components
- South/Central Puget Sound and Salish Sea:
 - External review draft reports (separate) distributed September 30
 - Joint advisory committee meeting week of October 7
 - Finalize reports in December, January
 - 2014-15 – refine Salish Sea model
 - Use refined Salish Sea models to inform regulatory decisions